

## Lesson Learned

### Severe Flooding Damages Transformer Substations

#### Primary Interest Groups

Distribution Providers (DPs)  
Generator Owners (GOs)  
Generator Operators (GOPs)  
Reliability Coordinators (RCs)  
Transmission Operators (TOPs)  
Transmission Owners (TOs)

#### Problem Statement

Record rainfall within a metropolitan area caused severe localized flooding at two large transmission substations, quickly rendering the stations and all terminating circuits unavailable and damaging telecommunication, protection, and station service equipment.

#### Details

A storm resulted in record rainfall of nearly five inches in a short period of time. During the height of the storm, three and a half inches fell within the span of two hours. The downpour resulted in severe localized flooding of two transformer stations, quickly rendering the stations and all terminating circuits unavailable.

The monitoring, protection, and control equipment housed at the transformer stations is located below grade in basements. Flood water damaged this equipment and caused a misoperation of protection and control systems that removed 26 230 kV and eight 115 kV connected circuits from operation.

This system event interrupted approximately 3,800 MW of load within the metropolitan area and required several days of combined effort between the RC, TO, TOP, and various DPs before all load was fully restored.

#### Corrective Actions

- Sandbags were applied to window wells of the relay buildings as a temporary repair.
- Any unsealed cable conduit penetrations were repaired and some equipment was relocated to above-grade locations.
- The floor drain check valves in the relay building were verified to be operating as designed and replaced if not.
- Both transformer stations are now equipped with gas-fired pumps, hoses, and fittings, and fuel to control storm water ingress in all control and relay rooms.

## Lessons Learned

- Entities should identify all transmission station buildings with critical power system equipment located below grade and which of these buildings are equipped with:
  - Floor drain check valves;
  - Sump pits or pumps; and
  - Diesel generator capability to power sump pumps.
- Flood protection equipment should be verified to be properly operating during station inspections.
- A mitigation plan should be developed for all buildings identified at key stations, and this plan should be included in future modification plans.
- Entities should consider relocating all replacement or new critical power system equipment in above-grade locations.
- Proper roof drains and grading for drainage at the building will help minimize the risk of flooded basements.
- Existing standards for cable conduit design should be revised to ensure that new and replacement cables supplying critical power system equipment enter the building via above-grade entrances. Where cable penetrations are below grade, ensure that they are routinely inspected and properly sealed.

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### For more Information please contact:

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[NPCC – Event Analysis](#)

Source of Lesson Learned:

Northeast Power Coordinating Council

Lesson Learned #:

20150402

Date Published:

April 21, 2015

Category:

Transmission Facilities

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